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**Datasheet for the decision  
of 3 May 2010**

**Case Number:** T 2042/07 - 3.5.02

**Application Number:** 99965762.0

**Publication Number:** 1127413

**IPC:** H03M 13/29

**Language of the proceedings:** EN

**Title of invention:**  
Efficient iterative decoding

**Applicant:**  
Qualcomm Incorporated

**Opponent:**  
-

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 54, 56, 84, 123(2)

**Relevant legal provisions (EPC 1973):**  
-

**Keyword:**  
"Clarity and support by the description - (yes) after amendment"  
"Inventive step - (yes) after amendment"

**Decisions cited:**  
-

**Catchword:**  
-



Case Number: T 2042/07 - 3.5.02

**D E C I S I O N**  
of the Technical Board of Appeal 3.5.02  
of 3 May 2010

**Appellant:** Qualcomm Incorporated  
5775 Morehouse Drive  
San Diego, CA 92121-1714 (US)

**Representative:** Geyer, Ulrich F.  
Wagner & Geyer  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 21 June 2007  
refusing European patent application  
No. 99965762.0 pursuant to Article 97(1) EPC  
1973.

**Composition of the Board:**

**Chairman:** M. Ruggiu  
**Members:** R. Lord  
E. Lachacinski

## Summary of Facts and Submissions

I. This is an appeal of the applicant against the decision of the examining division to refuse European patent application No. 99 965 762.0.

II. The reasons given for the refusal were *inter alia* that the claims of the main request and the auxiliary request were not clear and were not supported by the description, thus not meeting the requirements of Article 84 EPC.

III. The following documents of the state of the art have been cited respectively during the procedure before the first instance and by the board:

D1: S. Benedetto et al, "Iterative Decoding of Serially Concatenated Codes with Interleavers and Comparison with Turbo Codes", Proceedings of Globecom '97, pages 654 to 658; and

D2: D. Divsalar and F. Pollara, "Turbo Codes for PCS Applications", Proceedings of ICC '95, volume 1, pages 54 to 59.

This decision refers also to the following document of the state of the art cited in the application (page 3, lines 14 to 16) and in the International Search Report:

D3: J. Hagenauer et al. "Iterative Decoding of Binary Block and Convolutional Codes", IEEE Transactions on Information Theory, vol. 42, no. 2, March 1996, pages 429 to 445.

IV. In a communication accompanying a summons to oral proceedings of 22 January 2010 the board noted *inter alia* that it seemed that none of the available prior art documents suggested the termination schemes defined in claims 11, 17, 22 and 29 of the main request then on file.

Oral proceedings before the board took place on 3 May 2010. The appellant requested the grant of a patent in the following version:

Description

Pages 1, 19, 21, 22, 26 and 27 as originally filed;  
Pages 2 to 4, 4a, 11 to 18, 20 and 23 to 25 received during the oral proceedings of 3 May 2010.

Claims

Nos. 1 to 12 received during the oral proceedings of 3 May 2010.

Drawings

Sheets 1/5, 2/5, 4/5 and 5/5 as originally filed;  
Sheet 3/5 received during the oral proceedings of 3 May 2010.

V. Claim 1 reads as follows:

"A method of terminating an iterative decoding process being performed on a packet in an iterative decoder, comprising the steps of:

determining (206) whether a number of decoding iterations equals a predefined maximum number of iterations;

determining (214) whether a packet storage element

coupled to an input of the iterative decoder is filled to within a predefined percentage of the storage capacity of the packet storage element;

determining (210) whether the number of decoding iterations is greater than or equal to a predefined minimum number of iterations;

determining (212) whether an error-detection measure has been satisfied for the decoded packet on at least the previous iteration; and

terminating (208) the iterative decoding process for the packet if (1) the number of decoding iterations equals the predefined maximum number of iterations, or if (2) the number of decoding iterations is greater than or equal to the predefined minimum number of iterations, and the packet storage element is filled to within the predefined percentage of the storage capacity of the packet storage element, or if (3) the number of decoding iterations is greater than or equal to the predefined minimum number of iterations, and the error-detection measure has been satisfied for the decoded packet on at least the previous iteration."

Claims 2 to 6 are dependent on claim 1.

Claim 7 reads as follows:

"An iterative decoder (100), comprising:  
first and second decoding means (104, 110) for performing an iterative decoding process on a packet;  
packet storage means (102) provided at the input of the iterative decoder (100);  
means for determining whether a number of decoding iterations equals a predefined maximum number of iterations;

means for determining whether the packet storage means is filled to within a predefined percentage of the storage capacity of the packet storage means;

means for determining whether the number of decoding iterations is greater than or equal to a predefined minimum number of iterations;

means for determining whether an error-detection measure has been satisfied for the decoded packet on at least the previous iteration; and

means for terminating (116) the iterative decoding process for the packet if (1) the number of decoding iterations equals the predefined maximum number of iterations, or if (2) the number of decoding iterations is greater than or equal to the predefined minimum number of iterations, and the packet storage means is filled to within the predefined percentage of the storage capacity of the packet storage means, or if (3) the number of decoding iterations is greater than or equal to the predefined minimum number of iterations, and the error-detection measure has been satisfied for the decoded packet on at least the previous iteration."

Claims 8 to 12 are dependent on claim 7.

VI. The appellant essentially argued as follows:

The amended claims were based on claims 18 to 29 as originally filed, with clarifications based on page 22 of the description.

These claims related to the termination scheme, which in the communication accompanying the summons to oral proceedings the board had indicated was not suggested by the available prior art.

The description had been modified to acknowledge and cite the relevant prior art and to be consistent with the amended claims.

## **Reasons for the Decision**

1. The appeal is admissible.
2. *Allowability of amendments (Article 123(2) EPC)*

The claims of the present request are based on claims 18 to 29 of the application as originally filed. The substantive amendments to the claims consist only of clarifications, the various references to "previous packet[s]" in claims 1, 3 to 7 and 9 to 12 having been clarified on the basis of the passage of the description from page 21, line 32 to page 22, line 14, and the definition of the packet storage means in claim 7 having been clarified by using the wording of claim 1 (i.e. based on the original claim 18).

The description of the application has been amended to be consistent with the claims and to acknowledge the background art disclosed in documents D1 and D2.

Thus, the amendments to the application do not contravene Article 123(2) EPC.

3. *Clarity and support in the description (Article 84 EPC)*

The objections under Article 84 EPC in the decision under appeal concerned the definitions in the claims

then on file relating to the parallel decoding arrangement depicted in Fig. 1 of the application. The present claims define an unrelated aspect of the original application, and do not contain any of the definitions which gave rise to those objections. Thus those objections do not apply to the present claims.

Moreover, in the light of the amendments to the claims carried out by the appellant, the board considers that the present claims meet the requirements of Article 84 EPC.

4. *Novelty and inventive step (Articles 54 and 56 EPC)*

From the file it appears that, since the subject-matter of the present independent claims 1 and 7 was defined in the original independent claims 18 and 24, these claims have been the subject of search and substantive examination by the first instance.

The available prior art documents all relate to iterative decoders and methods of iterative decoding, with which the present application is concerned. However, the only one of these which explicitly describes termination schemes is D3, and that describes a scheme based on the calculation of a "cross entropy" criterion. The present independent claims define a termination scheme based on four different criteria (minimum and maximum number of iterations, degree of filling of the packet storage element and an error-detection measure). The subject-matter of the present claims 1 and 7 is therefore new in the sense of Article 54 (1) and (2) EPC.



The claimed termination scheme represents a simplification compared to the prior art of D3, since the calculations required for determining the specified criteria are simple, whereas the cross entropy criterion of D3 is very complex, as indicated in the application at page 3, lines 14 to 23. In particular, the prior art provides no suggestion of the criterion based on the degree of filling of the packet storage element. Thus, the subject-matter of claims 1 and 7 is considered as involving an inventive step in the sense of Article 56 EPC.

The subject-matter of claims 2 to 6 and 8 to 12, which are dependent on claims 1 and 7 respectively, is thereby also to be considered as being new and involving an inventive step.

5. *Formal requirements (Rules 42 and 43 EPC)*

Since the prior art does not disclose any of the termination criteria defined in the independent claims, the board considers that it is not appropriate to draft the independent claims in the two-part form (Rule 43(1) EPC). The claims and description have been amended to satisfy the requirements concerning acknowledgement of the prior art, consistency with the description and reference signs (respectively Rule 42(1)(b) and (c) and Rule 43(7) EPC).

## Order

### For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to grant a patent in the following version:

#### Description

Pages 1, 19, 21, 22, 26 and 27 as originally filed;  
Pages 2 to 4, 4a, 11 to 18, 20 and 23 to 25 received during the oral proceedings of 3 May 2010.

#### Claims

Nos. 1 to 12 received during the oral proceedings of 3 May 2010.

#### Drawings

Sheets 1/5, 2/5, 4/5 and 5/5 as originally filed;  
Sheet 3/5 received during the oral proceedings of 3 May 2010.

The Registrar:

The Chairman:

U. Bultmann

M. Ruggiu